Assessing the Vulnerability and Adaptive Capacity of Australian Settlements to Impacts of Climate Change and Variability

IDRC International Disaster and Risk Conference: from thoughts to action
25-29 August 2008, Davos, Switzerland

Dr Geraldine Li
Fenner School of Environment and Society
Overview of Presentation

- Acknowledgements
- Introduction to Integrated Assessment
- The IACCIUS project
  - Project aims
  - Methodology
  - ISRaVA Process
  - Case study focus
  - ISRaVA workshops
- Case study findings – some examples
- Key challenges and opportunities
- Conclusions
IA is a collaborative process and this study wouldn’t have happened without:

- IACCIUS partner jurisdictions – States & Territories of Australia: ACT Gov, Queanbeyan City Council, Cooma-Monaro Shire Council, City of Greater Bendigo, NT Gov.
- Funding agency: The Federal Australian Government Department of Climate Change (DCC)
- IACCIUS team from Fenner School (Steve Dovers, Geraldine Li, Paula Sutton, Joseph Guillaume, Mike Hutchinson, Katrina Proust, Rob Dyball, Pat Troy, Leo Carroll, Hons students: Alex Campbell-Wilson, Carina Wyborne)
Why do IA?

- Climate change, in both mitigation and adaptation, is a **systemic problem**, because:
  - Causes are deeply embedded in patterns of production and consumption, settlement and governance
  - Impacts are widely distributed across sectors and places
  - Strong connectivity both across and within categories of causes and impacts
Therefore, assessment approaches need to:

- Integrate environmental, social, economic factors
- Integrate research, policy and stakeholder communities
The Integrated Assessment Society:

- Integration of knowledge from different disciplines with the goal to contribute to understanding and solving complex societal problems, that arise from the interaction between humans and the environment, and to contribute in this way to establishing the foundation for sustainable development. Modelling and participatory processes should include stakeholder groups and the public at large.
One project funded under DCC Settlements Sub-program: (other projects are in Sydney, Tasmania, Melbourne, Gold Coast) about to conclude in June 2008.

Goal of DCC Sub-program is to increase focus on ‘urban’ impacts rather than traditionally on NRM sectors

IACCIUS focus was on

- small-medium sized urban settlements
- energy, water, urban vegetation, planning, extreme events and other issues of relevance to partners.
IACCIUS Project aims:

1. Insights into climate change impacts, vulnerabilities and adaptive capacity of case study settlements.

Final IACCIUS Project Reports

- IACCIUS Synthesis Report
- IACCIUS Methodology Report
- IACCIUS Climate Report

- IACCIUS Bendigo Report
- IACCIUS Darwin Report
- IACCIUS Cooma Report
- IACCIUS Queanbeyan Report
- IACCIUS Canberra Report

- IACCIUS Lessons Learned Report
- All Settlements Lessons Learned Report

- IACCIUS Evaluation Report
The IACCIUS methodology:

- Is an intent and a process, with emerging underlying principles and processes.
- Is undertaken within a range of frameworks.
- Is undertaken in a wide range of places, scales and problem contexts.
- Utilises a range of methods, according to need.
- Involves a variable range of groups and skills.
- Actively carries out reflexive and iterative research practice.
- Takes a complex systems view of settlements, which we’ve sketched to look like…
Figure 3 Generic Urban System
(Source: adapted from Boyden et al., 1981b, pp. 90-92, Figures 4.1, 4.2 and 4.3; and Millennium Ecosystem Assessment, 2003, p.37, Box 1.4)
...IACCIUS Methodology

Utilises multiple and different forms of information from across many disciplines:

- Social learning & stakeholder participation
- Systems thinking
- Urban studies
- Policy studies
- Climate science
- Risk management
- Vulnerability approaches (exposure, sensitivity, adaptive capacity)
- Uncertainty understandings

Integrating these methodologies became called the ISRaVA process

Geraldine Li, Davos Aug 2008

The ISRaVA (integrative systems risk and vulnerability assessment) Process:

- Ten broad steps conducted iteratively (which aligns with traditional risk management approach) and includes an ISRaVA workshop and subsequent detailed subsystems analyses
- With understanding of an urban settlement viewed as a system
- These ten steps can be summarised as:
<table>
<thead>
<tr>
<th>Risk Management Step</th>
<th>ISRaVA process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishing the context</td>
<td>1. Whole-of-system engagement (incl. PPP)</td>
</tr>
<tr>
<td></td>
<td>2. Local climate change and variability analysis</td>
</tr>
<tr>
<td>Identifying &amp; analyzing what’s at risk &amp; the vulnerabilities</td>
<td>3. Whole-of-urban system risk analysis (workshop)</td>
</tr>
<tr>
<td></td>
<td>4. Communication strategy</td>
</tr>
<tr>
<td></td>
<td>5. Policy history and ongoing policy processes</td>
</tr>
<tr>
<td></td>
<td>6. Assess vulnerability for the priority subsystems</td>
</tr>
<tr>
<td></td>
<td>7. Adaptation analysis</td>
</tr>
<tr>
<td>Evaluating &amp; reviewing the processes</td>
<td>8. Identify data/knowledge gaps</td>
</tr>
<tr>
<td></td>
<td>9. Disseminate/communicate findings</td>
</tr>
<tr>
<td>Treating the risks &amp; vulnerabilities</td>
<td>10. Implement adaptation strategies</td>
</tr>
</tbody>
</table>
IACCIUS project used a multi-method approach and remains open to the most useful methods for data collection and analysis. Method selected is dependent on the data source and the available skills and resources of the assessment team. Most common methods used in IACCIUS:

- secondary data: climate data analysis, risk and vulnerability assessment, systems analysis, spatial analysis, policy analysis, time series analysis
- primary data: systems analysis and participatory methods
Case Study Focus

- All towns: Settlement history and socio-demographic profiles; local climate variability and change analyses
- Cooma: Systems analysis; detailed analysis of tourism-economy subsystem
- Darwin: ISRaVA workshop; spatial differential vulnerability assessment, incl. water and energy consumption
- Bendigo: ISRaVA workshop; detailed analysis of sport & recreation subsystem
- Qbn: ISRaVA workshop; detailed analysis of storm water and impervious surface subsystem
- Canberra: ISRaVA workshop
Key Challenges and Opportunities

- Scoping and problem definition
- Stakeholder and urban system characteristics
- Flexibility and uncertainty
- Relevance to local decision making
- Adaptation, mitigation and adaptive capacity
- Participation and communication
- Workshop processes
- Data acquisition
### Summary of Private and Public Organisations

<table>
<thead>
<tr>
<th>Category</th>
<th>Private (PR), Public (PU), Community (CO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive and legislature; government agencies (national, state-provincial)</td>
<td>PU</td>
</tr>
<tr>
<td>Statutory authorities and other semi-autonomous public agencies</td>
<td>PU</td>
</tr>
<tr>
<td></td>
<td>PU-PR</td>
</tr>
<tr>
<td>Local government</td>
<td>PU</td>
</tr>
<tr>
<td>Public trading corporations</td>
<td>MX: PU, PR</td>
</tr>
<tr>
<td>Private firms</td>
<td>PR</td>
</tr>
<tr>
<td>Epistemic communities (organized around expertise)</td>
<td>PU-PR</td>
</tr>
<tr>
<td>NGOs, informal institutions, community-based organisations</td>
<td>CO-PU</td>
</tr>
</tbody>
</table>
### Summary projected trends for the ACT region

<table>
<thead>
<tr>
<th>Climate variable</th>
<th>Projected trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily maximum temperature</td>
<td>Increase – more very hot days, with daytime temperatures in summer possibly increasing more than the daytime temperatures in winter.</td>
</tr>
<tr>
<td>Daily minimum temperature</td>
<td>Increase – more warm nights, with night-time temperatures in winter possibly increasing more than night-time temperatures in summer.</td>
</tr>
<tr>
<td>Heatwaves</td>
<td>Increase.</td>
</tr>
<tr>
<td>Frost days</td>
<td>Decrease.</td>
</tr>
<tr>
<td>Summer humidity</td>
<td>Decrease - relative humidity and dew point to decrease in summer with decreasing rainfall.</td>
</tr>
<tr>
<td>Winter humidity</td>
<td>Possible increase - relative humidity and dew point may increase if rainfall continues to increase in winter.</td>
</tr>
<tr>
<td>Potential evaporation</td>
<td>Increase - particularly in summer with a decrease in summer rainfall.</td>
</tr>
<tr>
<td>Storm frequency and intensity</td>
<td>Projections uncertain. Summer rainfall may decrease. Winter rainfall may increase and with increased intensity.</td>
</tr>
<tr>
<td>Drought frequency and intensity</td>
<td>Likely to increase with decreasing rainfall, increasing potential evaporation and increasing maximum temperature.</td>
</tr>
<tr>
<td>Bushfire frequency and intensity</td>
<td>Likely to increase with decreasing summer rainfall, decreasing humidity and increasing maximum temperature.</td>
</tr>
</tbody>
</table>
ISRaVA Workshops

- ISRaVA workshops conducted with stakeholders involved:
  - Undertaking a preliminary assessment of the climate change impacts on the urban settlements using systems thinking and integration tools

- The workshop outcomes include:
  - The development of a systems diagram that incorporates key climate change variables relevant to the urban settlement and risks, vulnerabilities and impacts identified by workshop participants
  - From this a small number of priority issues or ‘subsystems’ identified by each jurisdiction in the workshop are agreed upon for investigation by the IACCIUS team.
  - Not all priority issues/subsystems were investigated by the IACCIUS team - the IA process intends to integrate across settlements, impacts and sectors.

Photo by P. Sutton.
1. Impact of low rainfall on the urban landscape:
   - the flow-on implications for liveability, recreation and sporting events. We have called the IACCIUS component of the study an analysis of “Pools, Parks and Playing fields”
   - impacts on the community’s health and wellbeing

2. Increased demands on local government

3. Impact on the elderly and other vulnerable groups
Further Subsystems: Bendigo’s ‘Pools’, ‘Parks’ and ‘Playing Fields’
1. Differential vulnerability
   - an analysis into which parts of the Darwin population are most vulnerable to the impacts of climate change. E.g. geographical (storm surge zone), built environment (cyclone wind intensity), socio-economic, seasonal migration and demographic flows

2. Water and energy consumption:
   - an analysis of water and energy use patterns and correlations with temperature and humidity

3. Impacts on liveability and visit-ability:
   - an analysis of the impacts of heat and cyclone activity on lifestyle and tourism in Darwin
Darwin - Integrated ranking of vulnerability to Climate Change

Legend

EMU analysis units

Ranking

1st (least vulnerable)
2nd
3rd
4th
5th
6th
7th
8th
9th
10th
11th
12th
13th
14th
15th
16th
17th
18th
19th (most vulnerable)

Derived from vulnerability assessment tables. This map should be used in conjunction with the more detailed vulnerability summary tables. It indicates areas where people and their surroundings in general may need additional preparation for changed climate conditions. Not all people or places in each area will be equally vulnerable (e.g., low vulnerability places may have higher physical risk but be better able to cope, and high vulnerability places may not be vulnerable to all impacts).

Geraldine Li, Davos Aug 2008
1. Economic impact from a reduction in Snowy Mountains tourism
   - an analysis into the vulnerability of the Cooma tourism sector to changes in climate

2. Impacts of climate change on water planning, including demography
Correlation between average snow depth and visitation by month

- Visitation rates in June, July, Sept. and Oct. show discernable correlation with snow depth (*snow conditions influence visitation more*)
- Less correlation in Aug. and Sept. (*snow conditions influence visitation less, peak season, school holidays*)

Sources: 
1. Energy and water supply and consumption
   ▪ investigate the impacts of climate change on energy and water consumption, with consideration of governance and population growth targets and water and emissions reduction and sustainability targets

2. Parks, gardens and landscapes
   ▪ investigate the biophysical and social impacts of climate change on urban parks, gardens and landscapes

3. Emergency management
   ▪ investigate the impacts of climate change on emergency management arrangements
- Aerial photograph series (taken in 2004, resolution of 75cm/pixel)
- Land-use information from QCC
- 2006 Population and Housing Census data (Social Atlas, ABS, 2008) - Pop. Density and Socio-economic status
- Qualitative data (interview and meetings)
- Observations on building type, size, age, landscaping and other characteristics

Geraldine Li, Davos Aug 2008
Conclusions/Recommendations

- Integrated approaches are necessary to deal with complex whole-of-society problems like climate change impacts on urban settlements
- IACCIUS project has provided a methodology for doing this for Australian urban settlements
- Ideally for state and local governments this can be done through a 3-step process:
  1. Whole of system analysis;
  2. Sub-system investigations; and
  3. Re-integration of sub-system analyses.
- Process should eventually be mainstreamed into organisations ongoing risk management, community, environment, planning and other processes
- Watch the DCC & Fenner/IACCIUS website for project reports and academic literature
Questions?

Contact:
- Email: geraldine.li@anu.edu.au

Darwin: Sunset. Photo by G. Li.